
Space Weather Technical Forecast

Issued on Thursday, 24 March 2022 at 00:43 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of slightly elevated geomagnetic activity today and Sunday due to coronal holes. Otherwise, mainly Quiet.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional C-class flares, and a peak of C4.3 at 23/2322 UTC from newly numbered AR2975, which continues to rotate on from the northeast limb. This region is now classified as Eki/beta, and so appears large and potentially magnetically complex. The other numbered region on the visible disc is AR2974, which is in the southeast quadrant and remains stable and classified as Cai/beta. No Earth-directed CMEs were observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was predominantly at slightly elevated levels, although occasionally dipped to background levels, peaking at 469 km/s at 23/2145 UTC. Density was mostly at average levels. The Phi angle was generally positive (away from the Sun), but had some temporary negative fluctuations. The IMF peaked at 10nT at 23/2316 UTC, with a north-south component range between -6 and +8nT and a somewhat erratic tendency between these extremes. Geomagnetic activity as a result of the above solar parameters was Quiet (Kp1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 were at background levels. The high energy electron flux (greater than 2 MeV) has been at Normal Background levels, and the 24-hour integrated electron fluence was well below the Active (1e8 integrated pfu) threshold, on a steady trend. Observed fluence at 24/0000UTC was 1.16e6 integrated pfu.

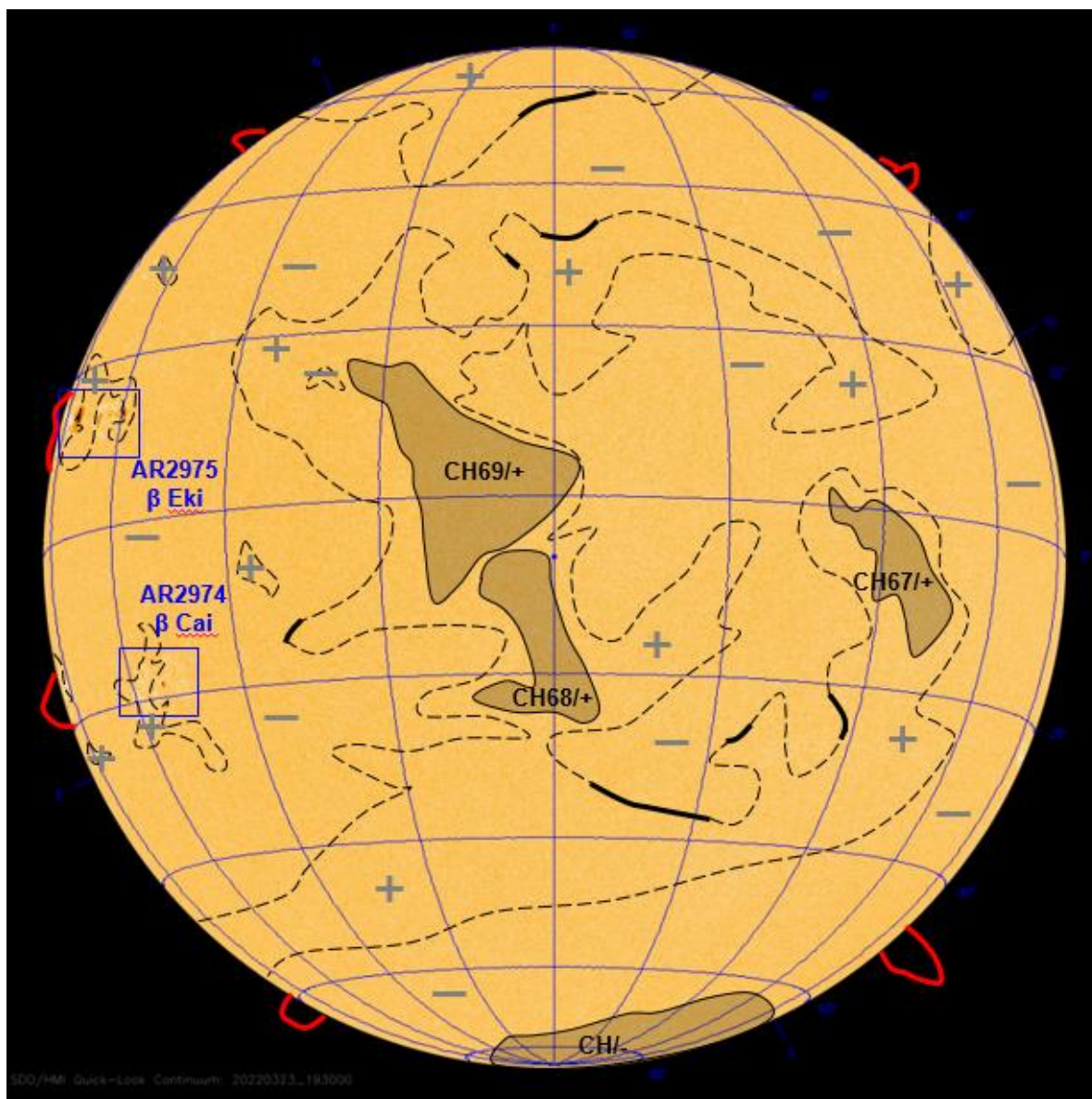
Four-Day Space Weather Forecast Summary

Solar Activity: There is currently a 70% likelihood of further C-class flares, a combination of both AR2974 and AR2975, and a slight chance (15%) of isolated M-class flares from AR2975. Further regions are also expected to rotate onto the visible disc over the next four days.

Solar Wind / Geomagnetic Activity: There is one possible weak Earth-directed CME in the forecast, potentially giving Earth a glancing blow around the middle of today (24 March). There is also a possibility of a slight coronal hole fast wind arriving as well today, most likely early today. Separately, these events are not likely to be significant, but will encourage geomagnetic activity, perhaps to Active (Kp 4) with a decreasing trend tomorrow (25 March). Day 4 (27th) a new high speed stream is expected to arrive, from CH68 and CH69 combined. Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp 1-3), with a chance of isolated Active (Kp 4) periods today and day 4 (27th).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels throughout the forecast period. The high energy (greater than 2 MeV) electron flux is currently at Normal Background levels, and is unlikely to increase in the near-term. A rise in flux and 24-hour integrated fluence levels is possible later in the period after the potential CME and coronal hole fast wind arrivals, but probably not to the active threshold. Fluence levels are therefore most likely to stay well below the Active (10^8 integrated pfu) threshold throughout.

Figure 1. Solar Analysis Valid 23/1930 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

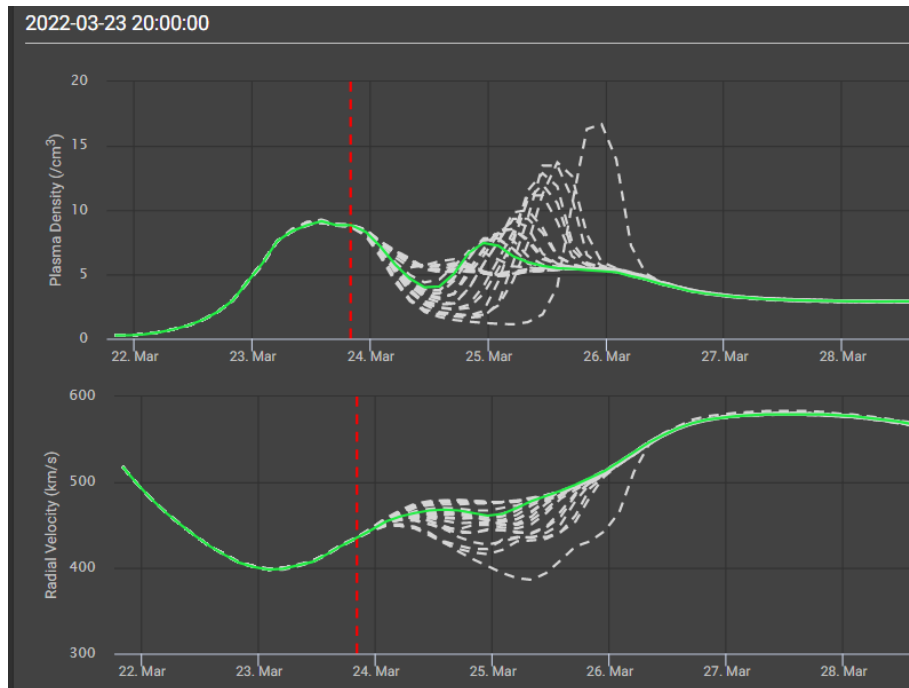
The solar wind has been slightly elevated and erratic over the last 24 hours, suggesting a transient feature of some sort has passed through, or perhaps a weak coronal hole fast wind. There is one possible slow Earth-directed CME in the forecast, associated with the 20/0745UTC C4.6 flare which emerged from the plage remnant of Ex-2971 in the northeast quadrant. This has been assessed and there is a slight chance of a glancing blow at Earth today (24th), probably around the middle of the day. No other Earth-directed CMEs feature in the forecast. There is also one non-persistent coronal hole high speed stream due today (24th March) from CH67/+ in the western hemisphere. This is both small and of positive polarity, and effects are likely to be muted as positive coronal holes are not favoured for a geomagnetic response at this time of year. However, the combination of the possible CME and coronal hole fast wind may give a slightly enhanced response, most likely up to Active (Kp4). STEREO-A data is currently inconclusive at hinting what the expected character of CH67 is, and also the following coronal holes CH68 and CH69. These are also both positive, and are expected to become geoeffective together during day 4 (27th), slightly increasing the chance of a G1/Minor geomagnetic storm.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	5	5	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
20/03/2022	Partial	Plage from Ex-2971	N09 E020	210km/s	24/2300 UTC	Slow CME directed towards NE following C4 flare.

Figure 2: Met Office ENLIL ensemble, showing little impact today from the potential CME arrival.



Radio Blackouts - X-Ray Flares:

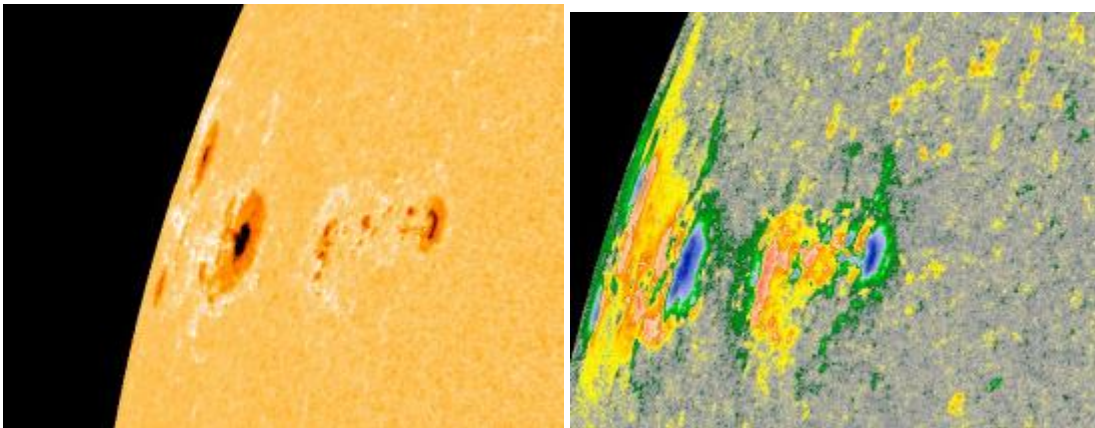
There are currently two numbered sunspots on the visible disc, as previous region 2972 has now faded to plage. AR2974 in the southeast remains stable and classified as Cai/beta. The second region is newly numbered 2975, which continues to rotate on from the northeast limb. The penumbra of the leading group has increased in areas over the past few hours, whilst the trailing spot is now more visible and appears large. This region is now classified as Eki/beta, and has already produced the largest flare, a C4.3, of the previous 24 hours. Either AR2975 is continuing to reveal itself over the northeast limb, or another new region is following closely behind AR2975 and will emerge soon.

There is currently a 70% likelihood of further C-class flares, a combination of both AR2974 and AR2975, and a slight chance (15%) of M-class flares from AR2975. Further regions are also expected to rotate onto the visible disc over the next four days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	15	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: AR2975, SDO HMI intensitygram (left) and SDO HMI magnetogram (right).

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 is expected to remain at background levels throughout the forecast period.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at predominantly Background levels, occasionally reaching Moderate. There is unlikely to be any significant high energy electron flux response from the various weak CH influence. Therefore the electron fluence is unlikely to reach the Active ($1\text{e}8$ integrated pfu) threshold through the forecast period. The general trend on MOSWOC REFM is currently flat and well below Active, which is accepted.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	5	10	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Met Office REFM model.

